





Eugene Gross

# FISSURA STERNI CONGENITA

NEW

## OBSERVATIONS AND EXPERIMENTS

MADE IN AMERIKA AND GREAT BRITAIN

WITH

## ILLUSTRATIONS OF THE CASE

AND

## INSTRUMENTS

BY

**EUGÈNE GROUX.**



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SECOND EDITION.

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HAMBURG, BY J. E. M. KÖHLER.

1859.



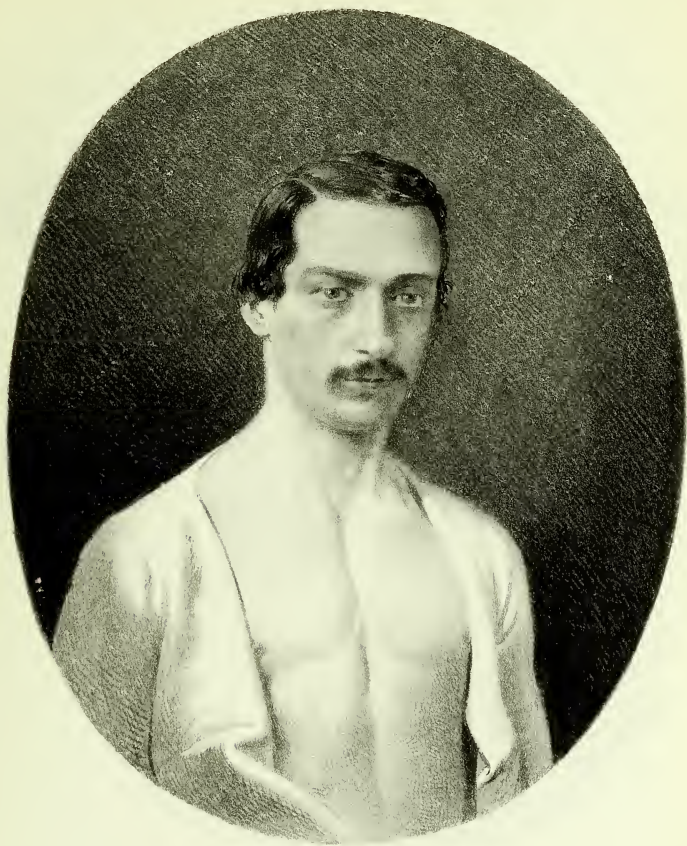
**This Work is respectfully Dedicated to the  
Medical Profession of the World.**

**By their Obedient, Humble Servant**

**EUGÈNE GROUX.**

**HAMBURG, Octobre 1859.**

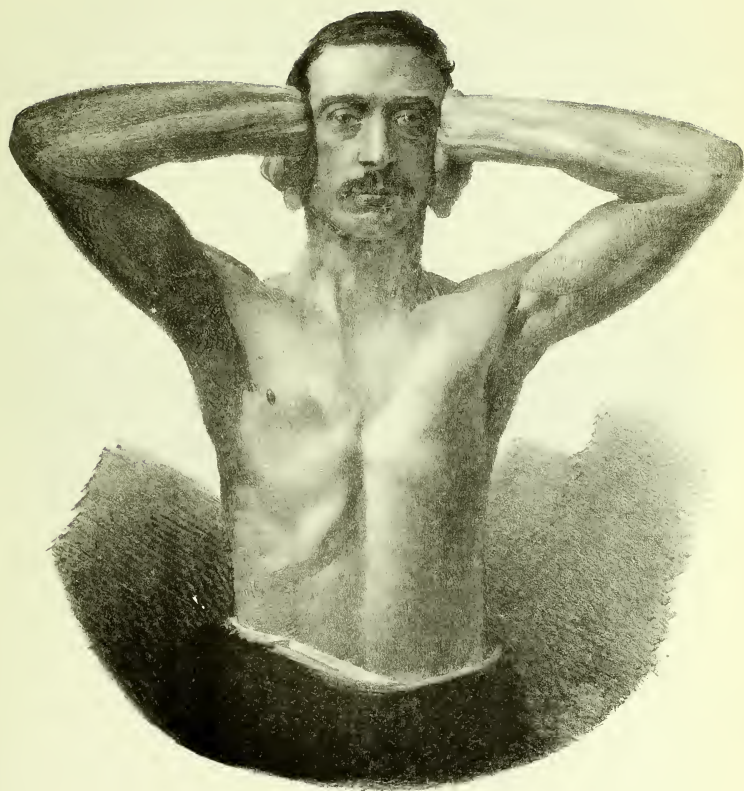




Drawn from Photographie by G. Meyer.    **PLATE 1.**    lith. by J. E. M. Köhler, Hamburg.

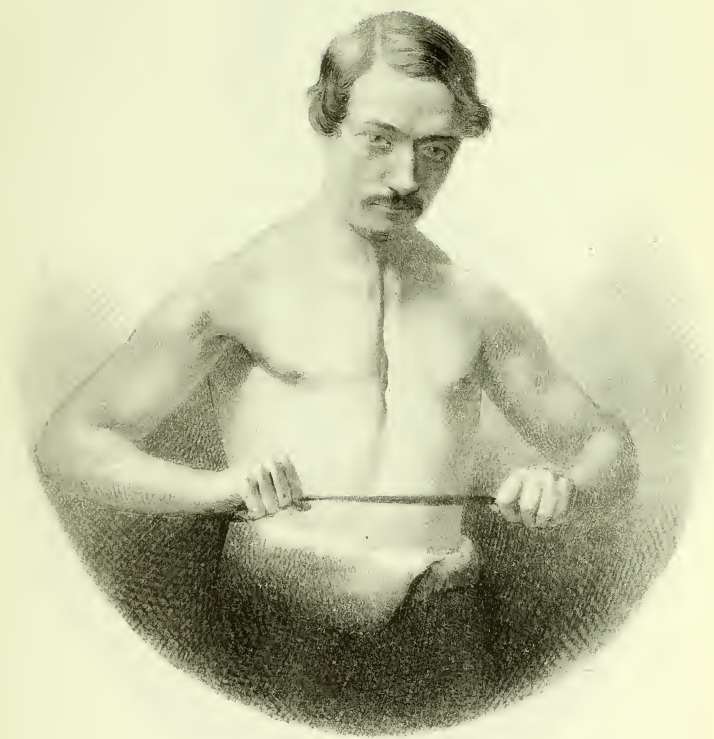






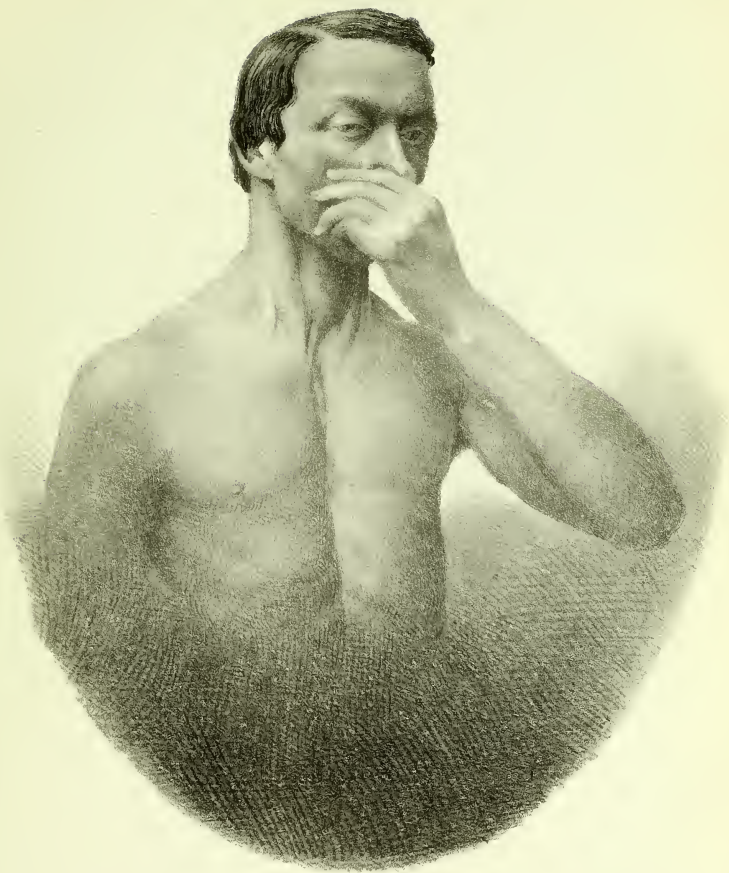
Drawn from Photographie by G.Meyer. PLATE 2. lith. by J.E.M Köhler, Hambarg.





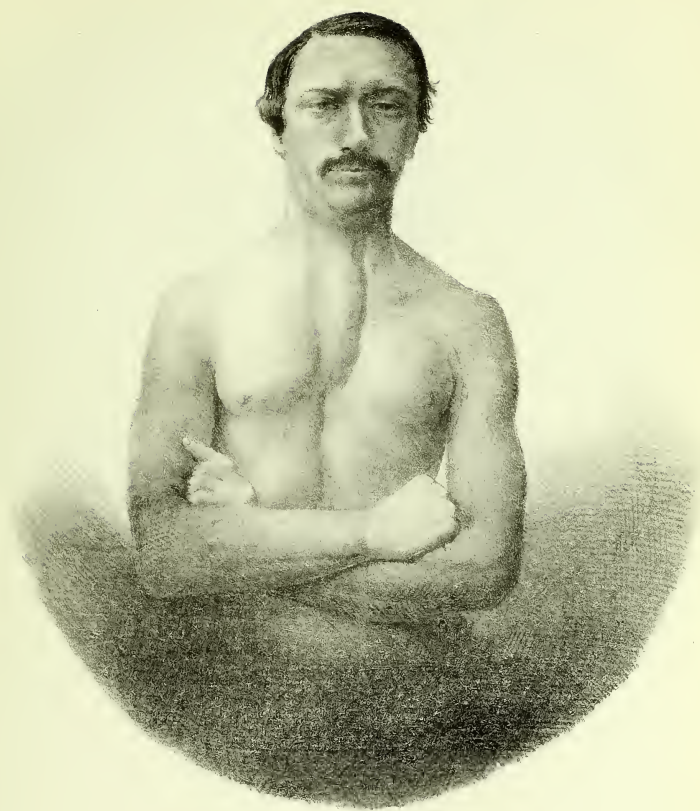
Drawn from Photographie by G. Meyer. **PLATE 3.** lith. by J. E. M. Kohler, Hamburg.





Drawn from Photographie by G.Meyer. **PLATE 4.** lith. by J.E.M.Köhler, Hamburg.

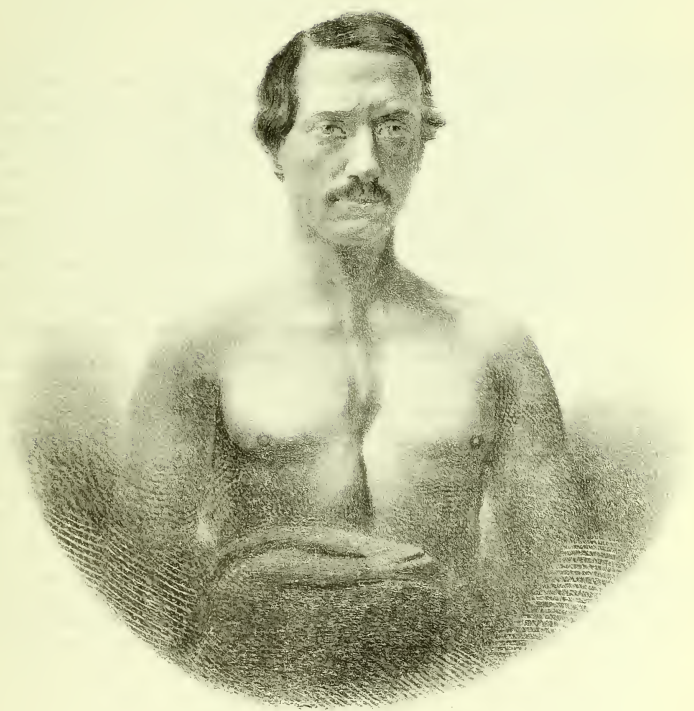




Drawn from Photographie by G.Meyer. **PLATE 5.** lith. by J.E.M.Köhler, Hamburg.







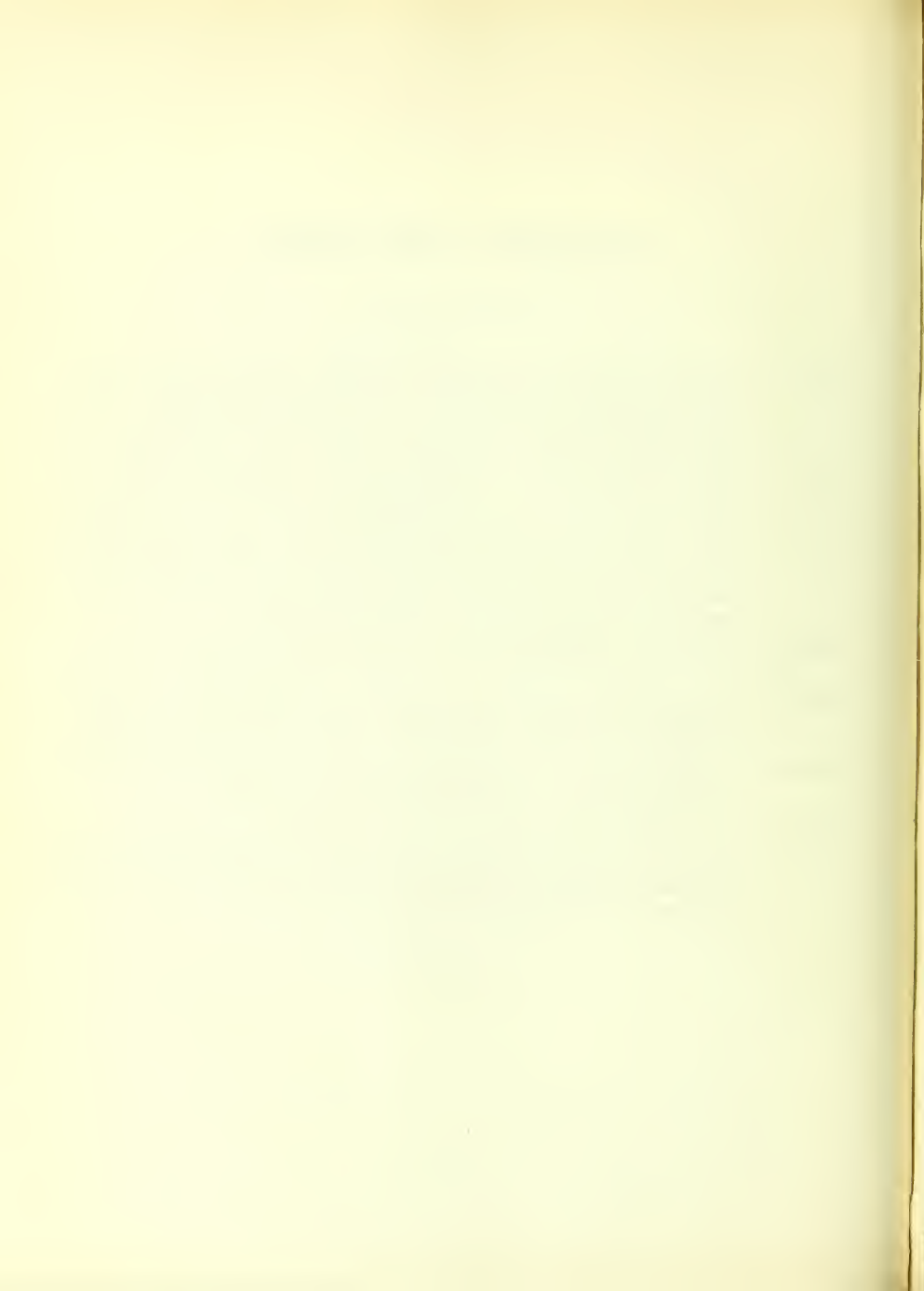
Drawn from Photographie by G Meyer. PLATE 6. lith. by J.E.M Kohler, Hamburg



## EXPLICATION OF THE PLATES.

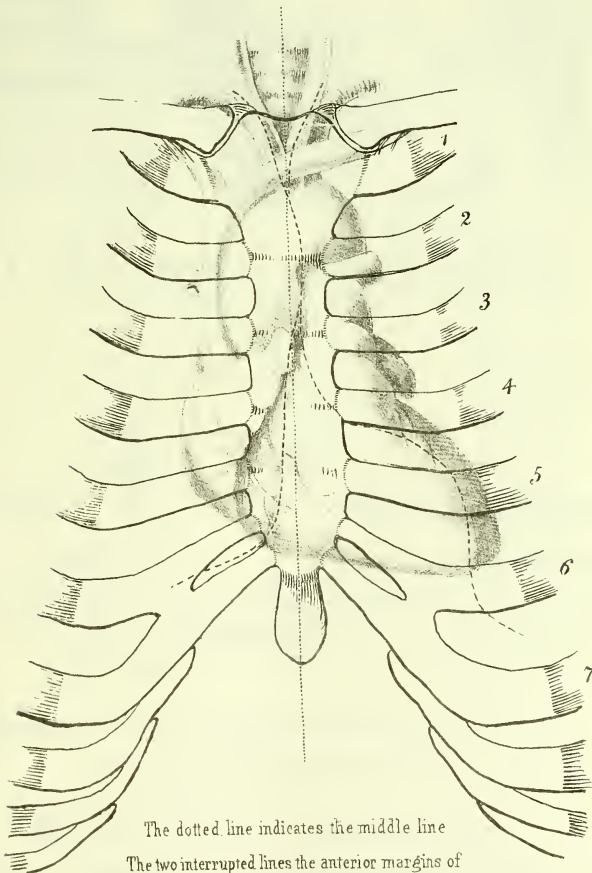
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- PLATE I. Natural state, we notice in the median line a longitudinal groove. The groove of course corresponds to the absent portion of the sternum. It is bounded on either side by a continuous hard ridge, which constitutes the lateral margin of the bone, and articulates with the costal cartilages. The skin passes naturally over the chest from one side to the other, but we see it raised in one part of the groove by a pulsatile swelling, which occupies the position of the right auricle of the heart. The clavicles and the two margins of the sternum above have no connexion with each other; but below, the latter are joined by a hardish substance which holds the situation of the ensiform cartilage, and forms the lower boundary of the groove. This substance, however, must essentially differ in structure from cartilage, for it possesses such elasticity as to allow it under the influence of the pectoral muscles, when the upper extremities are fixed, to open the groove to an extent of nearly three inches; it being only a little more than half this width, at its widest part, which is opposite the third and fourth ribs, when the parts are in a natural state.
- PLATE II. Opened fissure; or widened by reversed action of the pectoral muscles, the arms having been previously fixed, which is done by closing the hands and pushing them against each other.
- PLATE III. Closure of the fissure. It is done in two different ways. (a) By closing nose and mouth „see PLATE IV.” and taking a violent Inspiration (b) in fixing the arms and pulling a piece of India rubber tube. The fissure is closed through the actions of the deltoid and trapezius muscles.
- PLATE IV. Inspiration in closing nose and mouth the neck muscles sternohyoideus and thyroideus of the right side of the neck crossed over to be attached to the left piece of the sternum.
- PLATE V. The right lung is forced out of the fissure by a violent expiration.
- PLATE VI. Slow expiration the aorta, right auricle of the heart, and a part of the right ventricle can be seen; the aorta in the fissure corresponding to the 1th. and 2d. ribs; the right auricle of the heart in the fissure corresponding to the 3d. and 4th. ribs, the part of the right ventricle in the fissure corresponding to the 4th. and 5th. ribs.
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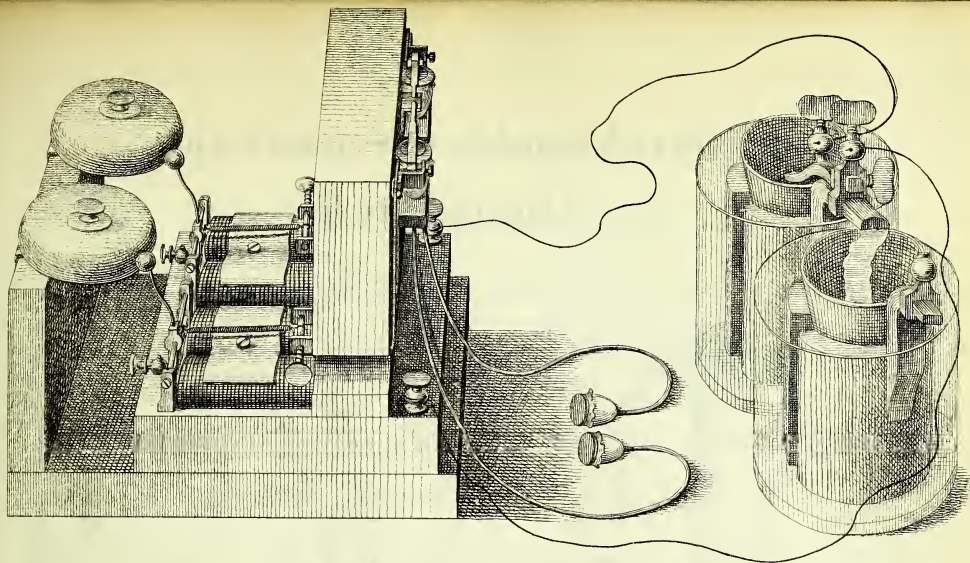
**DR ALLEN THOMSON'S**

Sketch illustrative of the Position of the Heart and Large Vessels  
as seen behind the Sternum & Ribs.



The dotted line indicates the middle line  
The two interrupted lines the anterior margins of  
the Lungs in a state of full insufflation. —



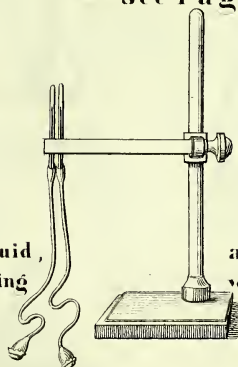


**Fig. I. Dr. Upham's sphygmophone.**

See Page 7.

**Fig. II. Dr. Scott**

is filled with a coloured liquid,  
connected by vulcanised tubing  
over at its mouth with



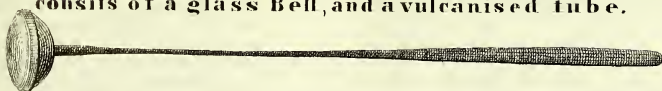
**Alisons sphygmoscope.**

and consists of a capillary glass tube,  
with a kind of elongated funnel, tied  
a piece of caoutchouc.



**Fig. III. Groux's stethoscope.**

consists of a glass Bell, and a vulcanised tube.

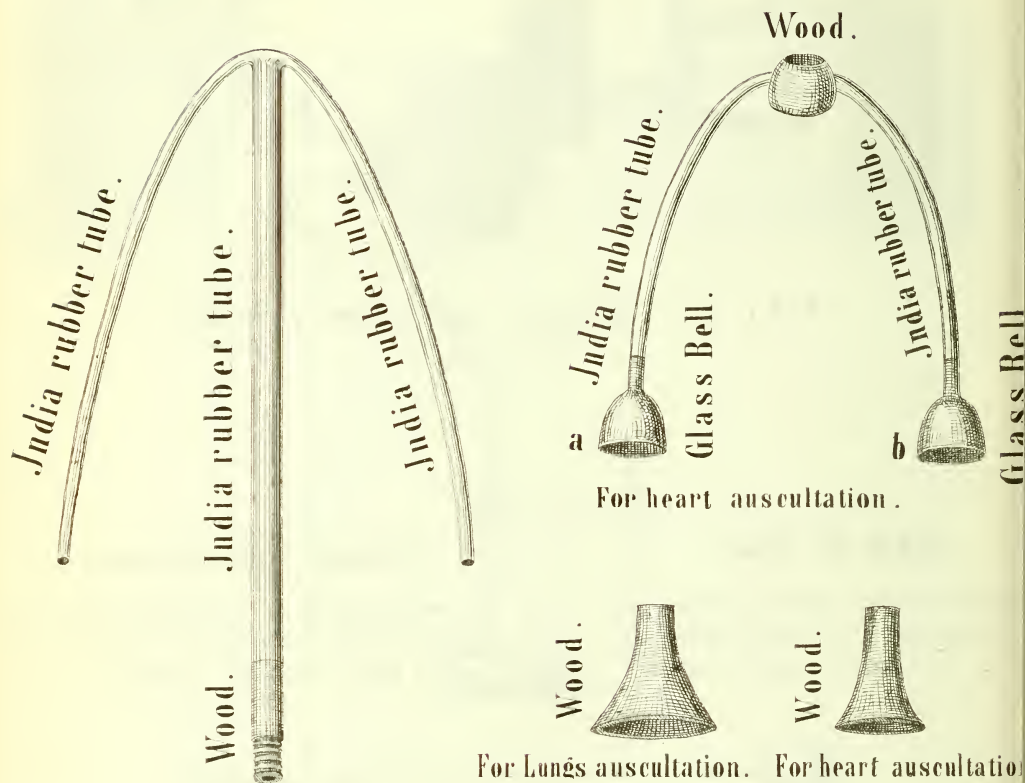


**Fig. IV.**

**Percussion hammer**, a brass ball with a narrow circumligation  
of India rubber, and a handle of caoutchouc.



# D<sup>r</sup> March double stethoscope. Cincinnati O.



This above instrument will be sold by H. Rost & C<sup>o</sup> Hamburg.



Die interstentielle Gewebungsbildung bei harten Geweben (nicht nachfolgende Bildung der  
 bindegewebigen) gibt uns Gelegenheit, einen Theil der Gewebungsart zu beschreiben.  
 Das im oberen Theil des Spalters sichtbare Falttümchen kann man von dem unteren Gewebe  
 unterscheiden; denn nur ein Theil mit ganz bestimmten Merkmalen ist immer sichtbar.  
 Bildung fähig, also nicht irgend einen Asthma. Die faserförmige Bildung  
 kann man in der Luftröhre des Menschen nicht in der Faserungseigenschaft derselben  
 begründet sein, der faserförmige Falttümchen ist also nicht durch die Luftröhre des Menschen  
 und nicht durch die Faserungseigenschaft hervorgerufen, ebenso wie der Falttümchen  
 Asthma. — Daß nicht das im 3. Theil faserförmige Falttümchen faserförmig  
 nicht durch die Faserungseigenschaft, sondern durch die Luftröhre des Menschen  
 erzeugt sei, bezeugt die Luftröhre des Menschen. Diejenigen der beiden Falttümchen  
 Lappen, welche zwischen der Faserungseigenschaft des linken Ventrikels mit der  
 Luftröhre verbunden ist, ist mit einer Chorde tendineae nicht an dem  
 Ventrikels mit dem Ventrikels, sondern an dem gegenüber sich befindenden Lappen  
 verbunden. Wenn also das ganz faserförmige Falttümchen, zwischen diesen Falttümchen  
 faserförmige Lappen von der Luftröhre her und nach der Faserungseigenschaft  
 zu, ist bezeugt die größte Luftröhre des Menschen derselben im Luftröhre  
 der größten Luftröhre des Menschen, in welchem Fall von Luftröhre des Luftröhre  
 nachfolgend ist. Wenn man das erste Falttümchen des Falttümchen, die Faserung dieses  
 Lappen hervorgerufen ist, so muß vollkommen die die Faserungseigenschaft mit dem  
 ersten Falttümchen des Falttümchen des Falttümchen, die die Luftröhre des Menschen, und die  
 einen bestimmten Luftröhre verbunden ist, hervorgerufen werden.

Freiburg den 26. Januar 1855. Dr. G. G. G.

fissure du sternum, permettant  
 de palpier le goitre aortique. Les  
 pulsations que l'on sent forte,  
 que l'on voit à la faveur de la  
 fissure sont isochrones aux pulsa-  
 tions des artères carotides, sous-  
 claviers, radiales, etc, et au choc  
 de la pointe du cœur. Cet organe  
 est bien conforme; les maternités  
 sont régulières, d'une force et d'une  
 étendue ordinaire; les claque-mus  
valvulaires sont distinctement  
 frappés, etc, etc. Donner 1855

We have examined the malformation in the  
 person of Mr. Green. It seems to us most probable  
 that the impulse seen and felt between the superior  
 portions of the sternum is due to the contraction  
 of the right ventricle; the heart being placed  
 somewhat above and to the left of the normal  
 position. In this view, what we have observed  
 in this case confirms the generally received opinion  
 respecting the sounds and actions of the heart.

Wm Burrows M.D.

James Paget

Since this letter was written August 3, 1855. —





Having had another opportunity of examining Mr. Jones after an interval of two years, I have been able to verify my former observations. We have also noticed two other points of interest respecting the motions & sounds of the heart.

Motions. That the visible pulsation in the middle third of the sternal vacuity is chiefly seated in the right auricle, appears to me obvious from its resemblance to the motion observed in the exposed heart of the ass. & from the fact, distinctly perceptible in slow pulsations, that this motion immediately precedes the ventricular systole & the onset of motion beginning with the auricle, & rapid passing downwards to the ventricle. In quick pulsations the motion of the auricle, as felt in the sternal space, & the systole of the ventricle as felt & heard in its region seem to be synchronous: but, I repeat in the more exuberant movements, when the pulse ranges above 65 in the minute, the unsalutic progression can be traced from the auricle to the ventricle, the upper margin of which sometimes comes into view at the lower portion of the sternal vacuity. To the rapid systolic movement succeeds a slow dilatation, & that this proceeds from the flow of blood into the auricle from the venous trunk is made more plain by the fact that pressure on the abdomen, & a force the blood on wards through the ascending vena cava, accelerates the expansion of the auricle. The aorta can be felt pulsating more deeply seated above the position of the auricle; & a like pulsation of the pulmonary artery may be felt through a portion of the auricle close to the left margin of the fissure.

Sounds. The sounds accompanying the respective motions can also be distinguished with clearness only in the slow pulsations. By aid of a small flexible ear tube with a narrow pectoral end, I was enabled to hear a distinct sound accompanying the contraction of the auricular contraction. This faint & short, or flapping sound in the left chest more distant sound of the ventricular systole. When the stethoscope is placed over

the ventricle, the flapping sound of the auricle is not heard, but the ventricle swells or rolls out its peculiar sound, till it ends with the sharp clash of the diastolic or ventricular sound. I infer from the preceding observation (as well as from similar ones made 20 years ago on animals) that each movement of the heart has its proper sound, & that the reason why the auricular sound is not usually heard, is that it is too faint to pass through the interfering lung & wall of the Chest.

The diastolic, valvular, or second sound, is remarkable for its clearness & singleness in this case; & on one occasion I found it reduplicated or double; & I had the opportunity of verifying the explanation wh<sup>ch</sup> I gave of this double diastolic sound more than 20 years ago. When the end of the stethoscope was placed over the aorta, above the auricle, the diastolic sound was single; but on carrying the instrument a little downwards & to the left, so as to cover a part of the pulmonary artery, the sound became double:—the whole heart sounds being altered by the sybbled, lubb-durrup, instead of lubb-dupp, as usual. — obviously from the two sets of valves closing in succession, not simultaneously. This want of coincidence in the closure of the aortic & pulmonary valves, is only occasional, but as it often presents itself as <sup>an occasional</sup> ~~the result~~ of disease, it is rather curious to be able thus to trace it to its cause.

The only planning observation wh<sup>ch</sup> I have to record is that of a short rushing murmur, heard in the course of the right carotid artery, but must be produced there, as it is not audible in the aorta or over the course of the innominate.

49 Upper Brook St  
London  
Nov. 18. 1857

J. H. Williams

Saint Louis April 1<sup>st</sup> 1859

Upon the invitation of the undersigned, a committee appointed for the purpose, a number of scientific and medical gentlemen, assembled in the O'Halloran Hall, College Buildings, to witness the experiments of Mons. A. Groux of Hamburgh, upon the action of his own heart.

The committee take this opportunity of expressing themselves as very much gratified by the exhibition, and return their sincere thanks to Mons. Groux. They also take upon themselves the pleasing duty of expressing the unanimous opinion of the gentlemen there present, that Mons. A. Groux deserves the gratitude of the Scientific world, for his untiring efforts in the promotion of that portion of science appertaining to the Physiology of the heart's actions, and the collateral branches

Montrose Hallen. M.D.

Thos. Kemmard M.D.

J. Hall M.D.

R. W. Diphant M.D.



Mit vielen Vergnügen habe ich Herrn Grönz  
 nach einigen Jahren wieder gesehen und die Experi-  
 menten, welche er nach dem Vorgange des Herrn Upham  
 macht, kennt von ihm vor einem grösseren Kreise von Arz-  
 ten und Studierenden in dem pathologischen Institute wiederholen  
 lassen. Die Chronologie der Puration der einzelnen Theile  
 wird dadurch auf die Klarheit dargestellt und der Beginn der  
 Puration in dem mittleren Theile der Lungenarterie kann nicht zwei-  
 felfhaft sein. Besonders bewirkt scheint mir aber der gleichzeitige  
 von Herrn Upham mit einem verbesserten Stethoscope dargestellte  
 unregelmäßige Anschlag-Ton, welcher dem doppelten Herztone vorange-  
 geht, zu sein; ich habe mich von der Existenz desselben vollständig  
 überzeugt und daher nicht zu, den Beginn der Bronchien  
 (mindestens der Trachea) vorliegenden und passirten Theile der im  
 Vorhofs angehörig anzunehmen.

Berlin, pathologisches Institut, 6. Juni 1859

Rud. Virchow.

Herr Grönz theilt mir mit, dass Herr Virchow Berlin  
 Abtheilung der inneren Medizin, welche sich in  
 der letzten Zeit sehr vielen Lungenentzündungen  
 myxomatösen, gelben Exsudat als mangelhaft eintrifft, durch  
 Luft. Ich denke, das auf mangelhafte, tief auf verformte  
 Lunge, deren die Lunge, wenn Herr Grönz die  
 entzündliche Lungen mit einem kleinen Lungen-  
 weiler, wenn die mit einem der Myxomatösen  
 betraffenen Lungen im demselben Verhältnisse zu  
 setzen.

A. v. Graefe

Berlin, am 6 Juli 59.





An extremely interesting case of congenital fissure of the sternum, which offers a rare opportunity for an intimate study of the motions and sounds of the heart and lungs, has attracted the attention of the medical profession of this city during the last month. The case is one not unknown to the world of medical science, for it has been the subject of much discussion during the last few years in all the learned societies of Europe, and has been treated upon in most of the medical journals in the different cities of Great Britain and the Continent.

M. E. A. GROUX, of Hamburgh, in whose person this almost unique conformation of parts is observed, has been examined by over 2000 physicians of the Old World, as the album which he carries attests. In it are found the autographs of the greater lights in our profession, from St. Petersburg to Madrid, and in many instances the detailed result of a critical examination is recorded.

We have been permitted to examine this album, and to transcribe some of these opinions. As this is an instance of a most rare anatomical disposition of parts, allowing an unusual facility for examining the phenomena presented by the heart during life, we consider every opinion upon the motions and the sounds of this organ, elicited by such a case, to be worthy of a more permanent record; we therefore, with M. Groux's permission, give here such of them as have not been already published.

Although this malformation is congenital, M. Groux was not aware of anything peculiar about it, till he was attacked by cholera, in 1849, when his attending physician detected it, and pointed it out to him. Since then it has been the subject of much scientific speculation, as the history of his presentations to the different societies and savans of all nations proves.

History furnishes but few instances of such a conformation of parts, and it is but recently that M. Groux when on a visit to Edinburgh, found that his case was not unique.

Dr. J. Hughes Bennett, who presented him to the Medico-Chirurgical Society of that city, exhibited at the same time a pathological specimen he had taken a few years before from the body of a woman, in which the sternum was cleft; a margin of bone existing on each side, to which the ribs were attached by their cartilages. This condition of parts was not known until the post-mortem revealed it

Harvey records the case of a young nobleman, in whose left side there was an opening, permitting the introduction of the fingers, and the examination of the heart by sight and touch. This was, however, the result of an accident, the ribs having been fractured by a kick of a horse, the injury terminating in destruction of the soft parts by ulceration, and thus opening the cavity of the thorax.

Dr. Lyons, of Dublin, in his observations on the case of M. Groux, mentions a third case, which in some respects has a more striking similarity to the one now under consideration. It occurred in a boy fourteen years old, deformed, with a lateral curvature of the spine, and consequent deviation of the ribs, some of which were imperfect. The first rib was perfect, articulating with the sternum; the second terminated at the distance of two and a half inches from the sternum, and the third, fourth, and fifth at three inches, while the rest were joined together, forming a semi-lunar arch. In the space between the ends of the ribs and the sternum, on the left side, covered only by skin, could be seen the movements of the heart and the lung.

These are the only cases known bearing any resemblance to the singular condition of parts which are to be seen in the person of M. Groux.

M. G. is about 28 years old, small in stature, but well formed. The remarkable peculiarity in his case consists in a fissure, which extends the whole length of the sternum at the median line, dividing it into two lateral halves. This fissure is of a V shape, with irregular outlines, covered with skin, and perhaps some of the fasciæ of the thorax; having its base upwards and its apex at the ensiform cartilage, where the two halves are held tolerably firmly together by a strong ligamentous band. During natural respiration the fissure is depressed at

variable depths, which can be increased by forced inspiration, giving it a concave appearance. The width of this fissure during quiet respiration is about one and a quarter inches at its upper boundary, an inch and a half upon a line with the third and fourth ribs, and a quarter of an inch at its apex. This width can be greatly diminished or increased at will by muscular effort. Through the action of the pectoral muscles, the hands joined together and pulling upon each other, the fissure is dilated to the width of about two inches and a half; while the hands being joined, and the effort being reversed—that is, pushing against each other—the fissure is lessened in width, can be closed entirely, and the edges be made to overlap even, through the influence of the deltoid and trapezii muscles. Forced expiration also increases this fissure, forced inspiration diminishes it.

Attentively examining this triangular space, a pulsating tumor is seen about its middle, on a line with the fourth rib. This is the most apparent pulsation, but there are two others in an almost vertical line with it, the one above and the other below, which can be felt; the latter is to a certain degree visible.

The motions and sounds of the heart perceived and felt in this triangular space have been the subject of the various opinions we are to give, but before we do so we must refer to other phenomena presented by this singular case.

By forced expiration, M. Groux is able to produce a large bulging tumor in the upper portion of this fissure, which upon percussion gives the clear sound of lung. This is the upper and anterior margin of the right lung, which is forced from under the margin of the right half of the sternum to fill up the fissure, giving it a convex appearance. Coughing develops this the best.

Another curious phenomenon is the wonderful power possessed by M. Groux of instantly arresting the pulsation in the subclavian and radial arteries. This is accomplished during full inspiration, the breath being held for a few moments while the lungs are full. It is probable that apices of the lungs press upon the subclavian arteries, and in this manner obstruct the circulation.

Still another experiment which is usually shown during the examination of this singular malformation is the enlargement of the pulsating tumor at the end of expiration, the lungs being completely exhausted, and the respiration suspended for a few moments. The tumor grows larger gradually, and the impulse of the heart is felt distinctly in the intercostal spaces of the third, fourth and fifth ribs. This is presumed to be owing to the distension of the heart by the blood during suspended respiration.

What is the pulsating tumor which is so apparent in the fissure? This is the mooted question. By some it is supposed to be the aorta, by others the right auricle, by others again the right ventricle, and by others still, the cone of the pulmonary artery or the arteria innominata.

*Dr. Lombard*, of Liege, who examined M. Groux in May, 1852, says, "The pulsations of the aorta were very distinct, and not synchronous with the auricle. The first were quite high, the second lower, and very visible to the eye."

*Prof. Hamerik*, of Prague, says, "The pulsating tumor is the right auricle, and not synchronous with the heart's apex."

*Dr. Wilhelm Reil*, of Halle, thus gives his opinion: "The tumor is the right auricle, because the dilatation is synchronous with the first sound of the heart, the first sound of the aorta, and the first sound of the pulmonary artery, but the radial is a moment later."

*Prof. Baumgartner*, of Fribourg: "The tumor is the right auricle, because only a body with transverse muscular fibres can produce this movement."

*Prof. Forget*, of Strasbourg: "It seems to me beyond question that the dilatable and pulsating tumor is the right auricle: 1. Because it occupies the position of the auricle; 2. Because it dilates to a considerable degree; 3. Because this tumor increases greatly in size when the subject separates the shoulders and suspends respiration; 4. Because behind and above this dilatation at the top of the sternum another synchronous pulsation is felt much more limited, much less expansive than the first, and which appears to me to be that of the aorta."

*M. Jules Declard* writes in the Gazette Hebdomadaire of Paris: "The right auricle forms, in fact, across the soft parts a tumor, the maximum diminution of which is synchronous with the shock of the heart against the pectoral walls, and with the arterial pulse, consequently with the ventricular contraction. \* \* \* It results from this examination that the shock of the heart is synchronous with the ventricular systole."

*M. Aran*, in his remarks before the Medical Society of the Hospitals of Paris, said, „It seems to me that there can be no doubt upon the point that it is the right auricle.“

*M. Bouillaud* states: „Fissure of the sternum, permitting the aortic pulse to be felt. The pulsations that can be touched, that can be seen by means of this fissure, are synchronous with the pulsations of the carotid artery, the subclavian, radial, &c., and with the shock of the point of the heart. This organ is well formed, the beatings are regular, of ordinary force and extent, &c.“

*M. Florry*—„I have ascertained that the heart is twelve centimetres in width; that it is the right auricle which beats in the place where the sternum should be, &c.“

*M. Pouchet*, Professor of Natural History in Rouen, says: „The pulsatile tumor can be only the right auricle. This is demonstrated by the region it occupies, by its movements of expansion, and by the considerable increase it undergoes during the act of coughing, and the suppression of the respiration—phenomena which could not be observed if it was the aorta.“

The late *Dr. John Snow*, of London, stated that „the motion observable to the eye in the situation of the right auricle is occasioned by the closing of the tricuspid valves during the contraction of the ventricles, which causes a momentary reflux or wave of blood into the auricle. I am of opinion that the proper contractions of the right auricle are not very apparent.“

*Dr. Geo. Burrows*, *Dr. Wm. Baly* and *Mr. James Paget*, Physicians and Surgeon to St. Bartholomew's Hospital, London, in their opinion, state: „It seems to us most probable, that the pulse seen and felt between the separated portions of the sternum, is due to the contraction of the right ventricle, the heart being placed somewhere above and to the left of the normal position.“

*Dr. Ernst*, of Zurich, says, in the Album, that the tumor is the right auricle, and he writes in Virchow's Archives—„It is clear that the part of the heart seen and felt contracts when it moves downwards. This motion is synchronous with the shock of the heart which is slightly felt between the fifth and sixth ribs.“

*Dr. Traube*, of Berlin, says that the tumor is the right ventricle, because the position of the right auricle is more to the right of the median line of the sternum.

*Prof. Virchow*, —„I think from vivisections and from anatomical and pathological specimens in which the mediastinum and the heart, in consequence of a diminution of the left pleura, are drawn more to the left side, are placed similarly to those in the case of *M. Groux*. Consequently I am obliged to believe that the pulsating tumor is a part of the right ventricle, in the greatest expansion of which the conus arteriosus joins.“

*M. Marc d'Espine*, of Geneva, concludes that the pulsations Perceived in the middle of the sternal fissure arise from the beatings of the aorta; „considering, 1. That each pulsation which is observed in the sternal fissure follows so immediately each systolic shock of the heart, that these two movements seem synchronous. 2. That there is an interval of appreciable time between the pulsation medio-sternal which *precedes*, and that of the abdominal aorta which immediately follows. That there is too great a distance between the regions where the pulsations which we are considering are observed, and that where the ordinary beatings of the heart are observed, for the pulsations to be attributed to the systolic movement of the ventricles.“

*Dr. F. W. Pavy*, of Guy's Hospital, writes in the Medical Times and Gazette, „The tumor occupying the position of the right auricle pulsates with the contraction of the ventricle and the production of the first sound of the heart. It rises rapidly and suddenly, and instantaneously afterwards falls with that peculiar thrill, wave or vermicular movement proceeding from above to below, which I pointed out as, at this period of the heart's action, running through the parieties of the *auricle* of the dog. It then remains at rest until again disturbed by a fresh contraction of the ventricle. From the behavior of this pulsatile swelling, so precisely corresponding to the action of the auricle in the dog, there is not a shadow of doubt in my own mind of its being formed by this portion of the heart.“

*Dr. Lionel S. Beale* says, „that the tumor consists partly of the right auricle and partly of the right ventricle.“

*Dr. Francis Sibson*: „The pulsating tumor at the upper part of the fissure is the aorta, and during inspiration the aorta alone is felt; but during a prolonged expiration the right auricle ascends, and it is then seen to dilate during the ventricular systole, to contract during the ventricular diastole; in fact, then, the aorta may be

felt pulsating at the upper part of the fissure, moving upwards and downwards, and the right auricle may be seen at the lower part of the fissure, moving from right to left, and *vice versa*. When M. Groux lies on the right side, I consider that the pulmonary artery presents itself, pulsating at the left side of the lower two-thirds of the fissure; when he lies on the left side, I consider that the right auricle presents itself to a greater extent than when he stands."

Dr. C. J. B. Williams has given a lengthy opinion, which we transcribe in full:

„*Motions*.—That the *visible* pulsation in the middle third of the sternal vacuity is chiefly seated in the right auricle, appears to me obvious from its resemblance to the same motion observed in the exposed heart of the ass, and from the fact, distinctly perceptible in slow pulsations, that the motion immediately precedes the ventricular systole, the wave of motion beginning with the auricle and rapidly passing downwards to the ventricle. In quick pulsation, the motion of the auricle is felt in the sternal space, and the systole of the ventricle as felt and heard in its region seem to be synchronous; but, I repeat, in the more deliberate movement, when the pulse ranges about sixty-five in the minute, the wave-like progression can be traced from the auricle to the ventricle, the upper margin of which sometimes comes into view at the lower portion of the sternal vacuity. To the rapid systolic movement succeeds a slow *dilatation*; and that this proceeds from the flow of blood into the auricle from the venous trunks, is made more plain by the fact, that pressure on the abdomen, which forces the blood onwards through the ascending vena cava, accelerates the expansion of the auricle. The *aorta* can be felt pulsating, more deeply seated, above the position of the auricle; and a like pulsation of the pulmonary artery may be felt through a portion of the auricle, close to the left margin of the fissure.

„*Sounds*.—The sounds accompanying the respective motions can also be distinguished with clearness only in the slow pulsations. By aid of a small flexible ear tube with a narrow pectoral end, I was enabled to hear a *distinct sound accompanying* the commencement of the auricular contraction. It is faint and short, or flapping, and ends in the less abrupt and more distinct sound of the ventricular systole. When the stethoscope is placed over the ventricle, the flapping sound of the auricle is not heard, but the ventricle swells or rolls out its peculiar sound, till it ends with the sharp clack of the diastolic or valvular sound. I infer from the preceding observation, (as well as from similar ones made twenty years ago on animals,) that each movement of the heart has its proper sound; and that the reason why the auricular sound is *not* usually heard, is that it is too faint to pass through the intervening lung and wall of the chest.

„The *diastolic valvular or second sound* is remarkable for its clearness and loudness in this case; and on one occasion I found it *reduplicated* or double; and I had the opportunity of verifying the explanation which I gave of this double diastolic sound more than twenty years ago. When the end of the stethoscope was placed over the aorta, above the auricle, the diastolic sound was *single*; but on carrying the instrument a little downwards, and to the left, so as to cover a part of the pulmonary artery, the sound became double; the whole heart-sound being expressed by the syllables *tubb-durrup*, instead of *tubb-dup* as usual, obviously from the two sets of valves closing in succession, not simultaneously. This want of coincidence in the closure of the aortic and pulmonary valves is only occasional, but as it often presents itself as a phenomenon of disease, it is satisfactory to be able thus to trace it to its cause.

„The only remaining observation which I have to record is that of a short rasping murmur, heard in the course of the right carotid artery, and which must be produced there, as it is not audible in the aorta or over the course of the innominate."

Dr. C. Radcliffe Hall and others of Plymouth, Torquay, state: „The most prominent pulsation is occasioned by the right auricle. It seems to us that three distinct degrees of distance of sound, indicating as many distinct sources, may be made out from above downwards; the sound over the presumed auricle being far more superficial and bell-like than either the one above (aorta,) or the one below (right ventricle)."

Dr. J. Hughes Bennett, Edinburgh: „Has no doubt that the pulsation above is that of the aorta, the prominent undulating one in the centre is that of the right auricle, and the inferior one observable on his taking a deep inspiration is that of the right ventricle."

Dr. W. T. Gairdner, of Edinburgh, also gives a lengthy opinion, which, as it has not been published, we give in full.



„The upper *visible* pulsation (A) is auricular; probably of the right auricular appendage.

„It precedes the arterial pulse which is felt above it by a very appreciable interval.

„It precedes the apex beat by an interval appreciable, but not so easily appreciable. Care must be taken to press lightly on the pulse A, in making this observation, otherwise the ventricle is felt pulsating below what I take to be the auricle, and is of course synchronous with the apex beat.

„It precedes the lower visible pulsation (B) by an appreciable interval. The only difficulty here arises from the fact that the movement is in opposite directions. B is rather a movement of retraction than a proper pulsation.

„The *pulsation A increases*, and the auricle *slowly fills under the eye* when M. Groux suspends respiration for a time. This phenomenon, like the welling of water into a basin which fills from below, can be easily distinguished from the protrusion of the lung which takes place when a sudden respiratory movement concurs with a closed glottis. When M. Groux coughs, the lung protrudes, but not the auricle; when he simply ceases to breathe for several seconds, without either expiring or inspiring, the auricle protrudes, but not the lung. Percussion also shows the difference between the two. This gradual filling of the right auricle when respiration is suspended, and the enlargement of its pulsations which follows, is quite in accordance with what is seen in vivisections, when partial asphyxia is gradually induced. In *forced* respiratory movement with the glottis closed, the protruded lung conceals the auricle, and interferes with the observation of its phenomena. In forced inspiration the heart is drawn back from the thoracic wall. The favorable state, therefore, for noticing the gradual filling of the auricle is intermediate.

„I presume the movement which I have called B (the lower visible pulsation) to be in connection with the systole of the right ventricle. It is only visible in full inspiration, because it requires the descent of the diaphragm to bring the heart down to the left costal margin, when this movement is observed, and it is a movement of retraction because the systole of the ventricle withdraws it from the surface. A similar movement is occasionally seen in men perfectly well formed, perhaps not in perfect health, but without marked disease of heart.

„During suspended respiration the apex beat in the usual situation becomes indistinct, and may, perhaps, finally be lost, though I have generally found it continue. At the same time a movement becomes apparent in the third, and then in the second intercostal space. This phenomenon is very curious, and well worthy the attention of physiologists. It was attributed by some of those who observed it at the Medico-Chirurgical Society here, to be an actual displacement upwards of the apex. I am rather of the opinion that it is owing to the increasing distension of the right ventricle, which throws back the true apex of the heart from the thoracic walls.

„In the strictly normal condition of parts, the same change takes place, so far as the disappearance of the true apex beat is concerned; but I have not seen the pulsation higher up except in disease. In adherent pericardium, and even hypertrophy of the right ventricle, it is not unfrequent. In M. Groux, when the heart's action is excited, it can be easily felt on deep pressure in four intercostal spaces simultaneously.

„With regard to the reduplication of the first sound which I formerly noted, I am still of opinion that it probably contains an auricular element, and is dependent on the want of synchronism between the auricular and ventricular contractions. But we are too little sure of the causes of the first sound, to allow of our speculating on the matter.”

Dr. P. Redfern, of Aberdeen, says: „I concluded that at the upper part of the fissure the aorta, or one or more of its branches, may be felt; that the undulating tumor at about the middle of the sternum is the right auricle, and that the one less easily seen, lower down and to the left of the fissure, is the right ventricle.

„I believe that the pulsations of the tumor at the middle of the sternum take place first, and that they are then succeeded by the synchronous pulsations of the lower sternal tumor and of the apex.

„The lungs do not approach the middle line in inspiration in M. Groux's case, because of the absence of the sternum and the depression of this part of the thoracic wall at that time by the pressure of the atmosphere; the lung is forced through the fissure during expiration simply because this part of the wall is weaker than the rest. It is unsafe to draw any conclusion as to the production of emphysema from this case.

„I believe both sounds of the heart to be produced by valvular tension entirely. Unless the auricles throw the blood with force into the ventricles, the auriculo-ventricular valves could not prevent copious regurgitation. The contraction of the auricle throws the valves upwards indirectly, and *may at times* produce such tension in them as to cause the faint flapping sound which is continued and completed at the first sound by the further tension caused by the succeeding ventricular contraction. Hence the reduplication of the first sound at times heard in M. Groux's case, and in disease. Even in this case I see no good ground for concluding that either muscular contraction or any other cause than the valvular tension is concerned in the production of either of the heart's sounds."

*Dr. Carlisle*, of Belfast, writes thus: „I do not think this pulsation is caused by the right auricle, because the movements of the auricle, when viewed in the beating heart in animals of warm blood, are of a different character. In such, during the systole of the ventricles, the auricles become gradually distended with blood from the venous trunks, and just as the systole ends, a portion of the blood passes suddenly from the auricles into the ventricles, whereby the size of the former is slightly diminished, but no active contraction appears at that time to take place in the auricles, this being the period of repose of the heart. Immediately afterwards a slightly marked peristaltic motion across the auricles commences in the right auricle, at the orifices of the *venæ cavae*. When this movement has reached the appendices, these suddenly contract and become flattened and somewhat hardened, and immediately afterwards the ventricles spring forward and assume the condition which denotes their systole. No movement takes place in either auricle which would cause the pulsation felt in the middle sternal region of M. Groux's case.

„I believe this pulsation to be that of the ascending aorta. If the fingers of one hand be placed along the surface of the seat of pulsation, in a line from above downwards, a single pulsation is felt by all the fingers so placed, extending from the lower to the upper boundary of the space as before described. If the ear be at the same time applied over the region of the apex and left side of the ventricular portion of the heart, the first sound and the impulse are found to be coincident with that pulsation, namely, with the augmentation in the size of the pulsating part, and the second sound coincident with the diminution in size and the receding under the fingers of the same part. If the radial artery be felt by the other hand, the pulsation above mentioned precedes the pulsation in the radial artery by an appreciable interval. For these reasons I conclude that the pulsation in question is that of the ascending aorta. It is possible that, at the lower part, the pulmonary artery, which there lies in front of the aorta, may contribute to form the pulsation, but I was unable to discriminate between the pulsation of the pulmonary artery and that of the aorta."

*Dr. Charles C. King*, Professor of Anatomy and Physiology to Queen's College, Galway, Ireland, says: „I am of opinion that the undulating movement from above downwards and towards the left side, and which is observable in the centre of the sternal fissure, depends upon the contraction of the right auricle of the heart, and the pulsation inferiorly and to the left side is produced by the right ventricle; its direction is upwards and to the right side; the auricular pulsation immediately precedes the ventricular. Immediately above the auricle the beat of the aorta can be distinctly felt. On placing the extremity of a small stethoscope very gently on the auricle a single sound is distinctly heard; on pressing more firmly, the auricle, or probably its appendix, yields, and the instrument comes into close relation with the origin of the pulmonary artery and aorta, and a double sound is heard. When the heart is beating quietly and slowly, a *double second* sound is perceptible. I attribute this to the flapping down of the pulmonic and aortic valves, not being perfectly synchronous."

*Dr. Robert D. Lyons*, of Dublin, Ireland, has, in a lengthy article which appeared in the *Atlantis* for July, 1858, analyzed all the motions and sounds of the heart observed in the case of M. Groux. The oval pulsating tumor he believes to be a part of the right auricle, having a single sound and a single impulse; another sound, deeper seated and double, is heard by pressing the stethoscope upon the walls over the auricle, which cause this part of the heart to recede; the first and single sound is superficial, and belongs to the auricle; the deeper seated are those of the pulmonary artery.

M. Groux has been presented to the Academy of Medicine, the Pathological Society, the German Medical Society, each of the Colleges, and to very many private societies in this city, in all of which the wonderful conformation of the thoracic walls, and the numerous experiments he shows to illustrate the sounds and motions of the heart and lungs, have elicited the greatest degree of interest.

(Opinions in the case of M. Eugene A. Groux; from *American Medical Monthly* for December, 1858.)

With the indulgence of the Society, I propose to offer an abstract of my recent experiments made in connection with M. Groux. And I do this, not with the expectation or intention of presenting you now any absolute mathematically exact results, nor with the attempt to point out, thus prematurely, the conclusions that may follow from a knowledge of the facts already obtained. All this, I am aware, requires much deliberation, and a rigid comparison and weighing of all the circumstances of the case. It is my object, rather, merely to describe the nature of the experiments themselves, and the conditions under which they were made, and to put on record here, as it were, the main facts, dates and localities in reference to them and the approximate results. And it is my purpose, at a future day, to draw up fully and minutely such statements as will bear the test, I hope, of scientific analysis and investigation. To this end, instruments are being constructed with a mechanism more perfect and delicate than any I have yet been able to obtain, and which shall exhibit and record with unquestionable accuracy the minutest possible intervals of time. In the recital of the descriptions which follow, I may have to repeat some particulars which many of the gentlemen now present have already heard.

To proceed—The experiments, now under consideration, were directed primarily and mainly to the elucidation of a single point in connection with the malformation of M. Groux—which point has, however, from the first, been made an essential element in the proper understanding of his remarkable and almost unique case, and about which the most eminent authorities have widely differed. This is, I need not say, the question of the synchronism or non-synchronism of the various motions of the heart and great vessels as displayed by M. Groux. To particularize still further, it is whether the impulse of the principal beating tumor (the main body of it) seen in the middle of the sternal fissure is, or is not, synchronous with the shock of the heart as usually felt at or about the space between the fifth and sixth ribs. In regard to this question of difference, let me quote from some of the authorities who have made particular mention on this point.

M. Bouilland, among the French, says: „The pulsations (referring to the medio-sternal tumor) are synchronous with the pulsations of the carotid artery, the subclavian, radial, and with the shock of the heart.” Prof. Hamernik, of Prague, says the pulsating tumor „is the right auricle, and not synchronous with the heart's apex.” Dr. Ernst, of Zurich, writes: „It is clear that the part of the heart seen and felt contracts when it moves downward. This motion,” he continues, „is synchronous with the shock of the heart which is slightly felt between the fifth and sixth ribs.” Dr. C. J. B. Williams says: „The visible pulsation in the middle third of the sternal vacuity immediately precedes the ventricular systole,” &c. Dr. Gairdner, of Edinburgh, observes, that „the upper visible pulsation” (meaning that of the medio-sternal tumor) „precedes the apex beat by an interval appreciable, but not so easily appreciable.” Dr. F. W. Pavy, of Guy's Hospital, says: „The tumor occupying the position of the right auricle pulsates with the contraction of the ventricle and the production of the first sound of the heart,” and he concludes, for this reason, that the tumor, which he admits to be the auricle, is put in motion by the contraction of the ventricle beneath. The Committee of the New York Pathological Society, appointed to examine the case of M. Groux, say, in their recently-published Report:\*) „The contraction of the tumor is synchronous with the impulse of the heart, at the level of the fifth rib.” Again, most of those who believe these motions to be not synchronous, agree that the pulsation of the tumor in question precedes that of the others in point of time. M. Marc. d'Espine, of Geneva, however, avers that „the pulsation in the middle of the sternal fissure follows so immediately, indeed, each systolic shock of the heart, that these two motions *seem* synchronous.”

The delicate and beautiful instrument of Dr. Scott Alison, of London, called the sphygmoscope, has added much to the facilities for determining this vexed point. But it has not settled the question, nor can it, in my opinion, be settled by this instrument alone, since it is impossible for the eye to observe with equal distinctness two points at the same time, however proximate they may be. How much is this difficulty increased when,

\*) This Committee consists of Dr. Peaslee, President of the Society, with Drs. Dalton and Metcalf.

as in the case before us, these two points are in motion—still more, since those motions are unequal. No so when the ear is appealed to. Any one skilled in the appreciation of harmony, *knows* that he can measure and determine, not two alone, but several sounds, resolving the component notes of a chord, struck severally at the same time, with unerring accuracy. With much greater facility can the ear—a musical ear—discriminate the minutest interval in a succession of sounds, especially if of different pitch. I might here enter into the discussion, as to how limited an interval can be appreciated between any two sounds before their impulses become blended, so as to form a continuous or musical tone. But this unnecessary to our present purpose. If there is, to the ear, an appreciable difference in time between two sounds, caused by the motions under consideration—provided the motions themselves are conveyed in equal times—then, I submit, these motions are manifestly not synchronous.

Such train of reasoning it was, as to the greater nicety of discrimination of the ear over the eye, so to speak, that led me naturally to the consideration of these experiments. Let me say, however; that I did not arrive unaided at the present form of their demonstration. Two ways, indeed, of accomplishing these results, at once occurred to me—one, and the more simple and obvious one, in the rude manner here depicted (of which this is the original pencil diagram\*); the other by calling in the aid of electro-magnetism. But of this latter agency I knew only of its ability to accomplish what I wished, somehow—by what precise manner of mechanism, I know not. Fortunately, I applied to my old friend and college-mate, Mr. Farmer † who relieved me of all difficulties on that score, by immediately suggesting the manner of accomplishing the ends desired, by means of the agency contemplated. The scientific reputation and ability of Mr. Farmer have long been recognized and acknowledged. All I can say in his praise would be wholly superfluous. I went so far with the first plan as to have a float made, with a piston attached, the object of which was to impinge directly against some light sonorous body, suspended or fastened in some way above. Such float, of delicate and ingenious construction, was devised by Mr. Joseph C. Wightman, which was admirably adapted to the purpose. Without fairly trying the first mode however, it was determined to resort at once to the second.

But without further preliminaries, I will pass to a brief consideration of the experiments themselves our disposal. Our forces were, on this occasion, divided—Mr. Groux, Mr. Farmer, Mr. Rogers and myself taking. The first trial was made on Tuesday, Dec. 21st, at the rooms of Mr. Farmer, in Washington Street. There were present Mr. Farmer, and his assistant Mr. Roger, M. Groux and myself. My original idea was to break the electro-magnetic circuit, by means of the motion, at the upper end of the delicate float, produced by the rise and fall of the fluid in the tube, as seen in the rough diagram I have before alluded to. At the first trial, however, Mr. Farmer suggested a modification of this mode, by dispensing altogether with the float, and attaching to the upper end of the tube a bell-glass and diaphragm, of the same nature as that already employed to receive the impulse from the heart—the medium of communication being air alone. Our operations were now confined to an attempt at breaking the circuit, so as to bring out, with two successive beats, their corresponding sounds from the electro-magnetic machine—a feat which was only accomplished after a long and patient effort, since it required, on the part of M. Groux and myself, the most careful and delicate adjustment of one end of the instrument upon the heart, while the other was brought by Mr. Farmer, with the unaided hand, against the circuit breaker of the electro-magnetic machine. In this way the whole of the first session, of some two hours duration, was employed.

On the next trial, which was made in the same place a couple of days afterward, we returned essentially to the first-named plan for interrupting the circuit, substituting for the material float of glass a few drops of acidulated water upon the top of the contained fluid, (within the glass tube), which, as it rose and fell with the heart's impulse, came in contact with the end of a conducting wire, and thus served the purpose intended. The instruments, of which we used two (and which, for the present, we may term the *sphygmophone*), then being applied, simultaneously, to the proper points, and the wires delicately held, each by an operator, we were able, by careful manipulation, to produce two or three sounds in succession from both the impulse of the medio-sternal tumor and the shock of the heart at its apex, and even now, though imperfectly, to demonstrate to the satisfaction of us all, the *non-synchronism* of these two movements. But the difficulty here, as with the sliding piston, was to follow the eccentric movements of the fluid, in the tubes, which rose and fell unequally with the slightest variation

\* It should be stated that a bell-glass, with an elastic diaphragm, after the manner of Mr. Scott Allison's sphygmoscope, is employed to receive the impulses from the heart and circulatory vessels. For want of time, the diagrams which ought to have accompanied these descriptions are not given.

† Mr. Moses G. Farmer, Electrical Engineer, and co-inventor, with Dr. Wm. F. Channing, of the City Telegraphic Fire-Alarm System.



of pressure against the body. To obviate this, resort was again had to the double diaphragm, as presenting, at all times, a known point; moreover the distal ends of the sphygmophone, being, in this case, themselves fixed, allowed, by means of simple mechanism, a very accurate adjustment of the circuit-breakers. A continuous elastic tube was, also, substituted for the glass cylinders which had hitherto intervened, and water, instead of air, used for the communicating medium. By these modifications our manipulations acquired, at once, more ease and certainty, and, being found to answer well our purpose, no further time was lost in perfecting the mechanism.

At the next session, therefore, we found ourselves in condition to obtain and to note satisfactory results. And our first design being to ascertain beyond question whether the impulse of the prominent pulsating tumor, in the middle of the sternal fissure, is or is not synchronous with that of the apex of the heart we made use of an instrument called the „Telegraphic Repeater,<sup>\*)</sup> which is so constructed that of any two motions, that which is first, by ever so brief an interval, moves its armature and produces its sound, to the entire exclusion of the other. It mathematically follows that, if the two communicated motions are *synchronous*, neither armature will move; this, however, presupposes a high degree of perfection in the mechanism. Suffice it to say, that, with this apparatus, the instruments being applied to the medio-sternal tumor and to the apex, it was the impulse from the first which invariably set in motion the corresponding armature and gave out its sound.

In our subsequent sessions, the „Repeater” was set aside, and a „Morse’s double register” used in its place. This was so adjusted as to give forth two sounds, differing in pitch, and at the same time record the motions on paper, in the same way that ordinary telegraphic communications are written. Then, by the intervention of the electric clock, which was also made to mark its seconds on paper, it was easy to measure the time of the pulse-beats themselves, as well as the interval in the pulsation of any two points in the round of the circulation.

Not to go, at this time, too minutely and tediously into description, I will only give the result by calculation of a few of these trials, including some witnessed by gentlemen present on the evening of the 5th of January inst., and afterward repeated in connection with the delicate chronographic apparatus in the Observatory at Cambridge. Before doing this, however, let me briefly allude to the Cambridge experiments, since they were in their nature, it is believed, both novel and interesting. They were done in the afternoon and evening of the 8th of January, Mr. Bond having, in the kindest manner, placed his beautiful apparatus in the Observatory at our disposal. Our forces were, on this occasion, divided—M. Groux, Mr. Farmer, Mr. Rogers and myself taking our position in the private apartment of the City Telegraph rooms in Court Square; and Mr. Stearns, the present able and efficient Superintendent of the Boston Fire-Alarm System, accompanied by Mr. Kennard, recently of the St. Louis Fire-Alarm Office, going over to the Observatory. The telegraph between the central office in Boston and the Observatory, let me add, was also kindly placed at our disposal—and, furthermore, I will say that the instruments used here were furnished from the City Fire-Alarm Office, and were the best of their kind.

At half past 3, P. M., a telegraphic notice from the Observatory signified that everything was in readiness there. But from the exhaustion and great nervous agitation of M. Groux, consequent upon recent illness, it was impossible to commence immediately the regular series of experiments, and nearly a couple of hours were spent in preliminary trials and tests. The line being found in perfect working order, the experimental apparatus at both ends also working beautifully, and M. Groux being now in a condition of comparative quiet, operations were commenced in earnest at about half past 5 o’clock. Some extracts from the original records, taken down in Boston and Cambridge simultaneously, will perhaps more graphically portray the nature of our proceedings.

To begin—the beat of the pulsating tumor in the medio-sternal space was tried. We were able to get several consecutive beats, which were also duly recognized at the Observatory. Next, a series of apex-beats was obtained, and recognized at the Observatory. The Observatory clock was now put in connection, and its tickings made audible and recorded in Boston.

The experiments then proceeded, as follows:

The impulse of the medio-sternal tumor and of the pulse at the wrist were taken together, and at the same moment recorded at the Observatory. As the experiments now went on, they were interlarded with telegraphic queries and answers; and for the sake of clearness, we will prefix, when necessary, the words *Boston* and *Cambridge* to the parts of this dialogue, according as they emanated from the one place or the other.

<sup>\*)</sup> This is an instrument used in telegraphing *through* messages over long lines. It is the joint invention of Mr. Farmer and the late Mr. A. F. Woodmann, of Portland.

After the experiment just alluded to, information was conveyed that it would be repeated.

*Cambridge.*—"Aye, aye."

*Boston.*—"Good signals these, save them."

*Camb.*—"Shall we put in the clock now?"

*Bost.*—"Yes. And as our next experiment, we will try the apex and wrist."

*Camb.*—"Go ahead."

*Bost.*—"Any good signals then?"

*Camb.*—"Yes, one or two."

*Bost.*—"We will try that again. Any of these good?"

*Camb.*—"Some of them very good."

*Bost.*—"About what difference in time between the beats in this experiment?"

*Camb.*—"About two tenths of a second."

*Bost.*—"In which does the difference appear greatest, this or the preceding experiment?"

*Camb.*—"Should say the former."

This question being repeated after additional trials, the reply was, "Wait till we can calculate them"; and, shortly afterward, an answer was received, "The former, by a minute interval."

*Bost.*—"Now we will pass to another experiment. Do you get a single or double stroke?"

*Camb.*—"No good double stroke, but something that looks like it."\*)

*Bost.*—"Try again; how is that?"

*Camb.*—"Better."

*Bost.*—"Once more; how now?"

*Camb.*—"Better still."

*Bost.*—"We will now repeat these three experiments in succession."

Toward the close of the session, the operators at the Observatory were requested to count the beats to be sent over during the space of one minute. I then applied the instrument to the radial artery at my own wrist, an assistant taking the pulse at the other wrist. It was ascertained by counting to be sixty-six in the minute. The question was now put to Cambridge, "How many?"

*Camb.*—"Sixty-six."

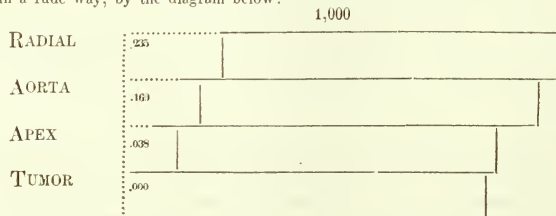
*Bost.*—"Once again."

Mr. Groux now applied the instrument to the medio-sternal tumor, for the period of a minute, and its pulsations were found to be seventy-two. The query was again put, "How many?"

*Camb.*—"Seventy-two."

But the above will suffice to show the nature of our proceedings; this session was continued without intermission for six hours.

The following are some of the important results obtained which bear upon the question at issue; the whole number of sessions thus far has been ten, of an average duration of two hours each—the calculations (made by Mr. Farmer) are based on the average of selected examples taken from all the experiments. They are expressed, in a rude way, by the diagram below:



\*) The operators at the Observatory were not informed previously of the nature of this experiment. It was an attempt to record the medio-sternal and apex beats by applying the sphygmographes to these points direct—an exceedingly delicate test, tried repeatedly with success in our private experiments. Prior to the response from Cambridge, Mr. Farmer remarked, that with a single line of communication only, it would be impossible to note clearly so minute a double beat at the Observatory.

and may be thus stated. The whole duration of the pulse-beat is represented by 1,000. Then the commencement of the beat proceeding from the medio-sternal tumor being .000, the interval to the apex-beat was found to be .038; to that of the ascending aorta, at its junction with the arch, .160; that of the radial artery at the wrist, .235; being in thousandths of a pulse-beat.\*)

Lastly, when at the final session (on the day preceding M. Groux's departure to Philadelphia), the ends of both the instruments were placed, as nearly as possible, over the apex of the heart, the result, both to the ear and as recorded by the chronograph, was absolutely a synchronism of sounds. Calculations were also made as to the time in which the heart's impulse is transmitted to the carotids, the temporal arteries, the abdominal aorta, and other points in the circulation, which, with other experiments, may be given at some future time.

As to any practical advantages which may be derived from a knowledge of these facts, it would, perhaps, be premature now to speak. I would venture to suggest, however, as one probable result of these and similar illustrations, some additional means to our resources for diagnosis in aneurism and other obscure diseases of the aorta and great vessels, concealed in the cavities of the thorax and abdomen. But let me say, in conclusion, as I intimated at the outset, that the results above given and the opinions offered, as well as the experiments themselves, in their present stage, are at best imperfect, and that before any ultimate scientific deductions can with safety be made, the experiments must be repeated, again and again, with the most perfect apparatus possible, and all errors and inaccuracies eliminated by a multitude of trials.

31 *Chesnut Street*,  
*Boston, Jan. 24th, 1859.*

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(Some Account of the Recent Experiments made in Connection with the Case of M. Groux.)

By J. B. Upham, M.D., Boston.

(Read before the Boston Society for Medical Improvement, and communicated for the Boston Medical and Surgical Journal)

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M. E. A. Groux has again returned to New York, after having made the tour of the United States. He has visited all of the leading cities in the Union, and has submitted his case to the examination of most of the principal physicians. The tumor seen in the fissure of the sternum has been the subject of inspection and speculation wherever he has been. We have been permitted to examine his album, in which he collects the autographs and the opinions of all those who have critically examined the movements and sounds of his heart, and have been allowed to extract from it such as will complete the history of this case up to the present time. We have already collected in one paper, in a previous number of the MONTHLY, (Dec., 1858,) the opinions of the leading physiologists of Europe on this interesting case, and we published the Report of the New York Pathological Society in full in the January number of the present year. To these we now add two more, which are the only ones we find in M. Groux's album which merit being recorded as an opinion.

The first is the result of the brilliant experiments of Dr. J. B. UPHAM, of Boston, alluded to in a former number.

Dr. Upham says: „My object was to demonstrate to the ear, through the agency of electro-magnetism, the facts in the mooted question as to the synchronism of certain of the motions of the heart and great vessels, displayed in the case of M. Groux; and, in this connection, also, to measure accurately the time in which the heart and pulse are conveyed from the centre of the circulation to points more or less remote.

„The following results appeared, viz.:

„(a.) That a minute but distinctly appreciable interval of time elapsed between the impulse of the oval tumor seen in the middle of the sternal fissure and the shock of the heart between the fifth and sixth ribs.

„(b.) That a slightly increased interval was manifest between the impulse of the tumor and the beat of the aorta at its arch.

„(c.) That a still greater interval was perceptible between the tumor and the radial pulse:

„(d.) That the interval between the apex beat and the radial pulse was slightly but appreciably *less* than that between the oval tumor and the radial, and greater than in the case of the first two experiments named.

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\*) Taking the Cambridge experiments alone, and the above intervals would be expressed by the figures .054, .156 and .237 respectively.

„All these experiments were minutely recorded by means of a chronograph, delicately adjusted for the purpose, it being found possible by this means to record intervals of time considerably less than the one-hundredth part of a second.

„The calculations of these minute periods of time are withheld till a greater number of experiments shall have placed their accuracy and trustworthiness beyond question.

„The electro-magnetic apparatus on this occasion was under the supervision of Mr. Moses G. Farmer, the eminent electrician, assisted by Messrs. Stearns and Rogers, from the City Telegraph Office. On Saturday, January 8th. these experiments were in the most careful manner repeated, in connection with the delicate apparatus in the Observatory of Cambridge, and verified in every essential particular.”

The other is that of Dr. J. Dacosta, of Philadelphia, who writes:

„The pulsating mass seen through the fissure in the sternum, I believe to be the auricle; it is certainly not the aorta. This seems to be proved from the fact that during a held expiration the fissure fills up, and a mass protrudes, the upper portion of which is clear, partly tympanitic on percussion; the lower (*i. e.*, the one corresponding to the point which was observed to be in motion) is dull. If the position of the parts be normal, is it possible for the aorta to be thus displaced?

„The opinion that this distinctly pulsatory mass is not the ventricle, I base on its peculiar undulatory movement, its position, which hardly corresponds to the right ventricle, and the entirely different character of sound heard over it and the mass at the lower part of the fissure.

„*Sounds.*—Presuming, then, this to be the auricle, I studied on several occasions, and different positions, the sound heard over it. It may be described as one sound, whose commencement is different from its close. The sound is sometimes buzzing, but most usually of high pitch, and rather metallic sounding. The click at its end is often very marked. It differs entirely in its character from the first sound heard over the right or over the left ventricle, both of which are of much lower pitch. It is more like the second sound, heard higher up over the aorta, but also differs in character from this, being much more ringing and metallic. In estimating whether it be really produced in the auricle, it is necessary to compare it with the valvular sound of the aorta, as the question suggests itself, whether it be not this transmitted. The peculiar click heard at its termination corresponds to the drawing away of the integument from the end of the glass stethoscope, as may be easily proved. A similar sound is heard by placing the stethoscope at other points of the chest, and listening when the thoracic walls recede. The observations were made with M. Groux's glass stethoscope, and repeated with a glass stethoscope placed in Cammann's double stethoscope.

„*Aortic Sounds.*—Two sounds are heard at the aorta. The first, a dull, long sound; the second, sharp and accentuated. If the finger be placed immediately below the stethoscope, two impulse are felt. The first and longest vibration corresponds to the first, or long sound; the second impulse communicated to the finger is short, but decided, and corresponds to the second, distinct, flapping sounds. This double impulse over the aorta seems to me to account for the wavy, irregular motion of column of fluid over the aorta in the instrument M. Groux employs, and would explain the fact that observations made simultaneously with a stethoscope, and by the application of the hand over different parts of the heart, seemed hardly to correspond with the results obtained by the delicate instrument employed.

„By placing pieces of bone, of gutta percha, etc., in the upper part of the fissure, the aortic sounds, although not as marked, still retained their distinctive character.

„*Effects of Respiration of the Heart.*—In full inspiration, the sound over the auricle disappears entirely, and returns completely in full expiration. The sounds over the left ventricle lessen in inspiration, and both ventricles are turned inward, so that the beat of the heart is perceived somewhat downward, and towards the median line; a fact of which I had become fully aware, by observations made prior to seeing M. Groux.”

M. Groux expects to return to Europe soon, but proposes, before going, to deliver a public lecture upon his own case, to repeat the numerous experiments made by Dr. Upham and others, and to illustrate them by vivisections. He has already lectured in several of the cities he has visited, and is prepared to give an extremely interesting discourse upon the phenomena witnessed in his person.

The lecture is proposed to be given on the evening of May 10, at the Cooper Institute.